



# MT365

## Errata

### Handbook

- Page 16      **Algorithm for finding an Eulerian trail in a digraph**  
Replace each occurrence of the word 'cycle(s)' in the algorithm with 'closed trail(s)'.
- Pages 29, 31      In the final sentence of step 7 of **Part C** of the Hungarian algorithm insert 'remove any edge which now has a non-zero cost' between '...the partial graph,' and 'delete all labels, ...'.
- Page 33      In **6 Perfect codes**, in the two mathematical expressions on lines 4 and 7, the capital L should be an ellipsis i.e. three dots. ....  
In **Theorem 3.2** delete 'a code with a systematic encoding rule – that is,'.  
At the end of the sentence below Theorem 3.2, insert 'and conversely, if the generator matrix  $\mathbf{G}$  is expressed in standard form  $\mathbf{G} = [\mathbf{I}|\mathbf{A}^T]$ , then the matrix  $\mathbf{H} = [\mathbf{A}|\mathbf{I}]$  is a parity check matrix for  $C$ '.
- Page 44      In **Theorem 2.1**, the word 'binary' should be deleted.
- Index      The following index items should be as follows:  
complete graph **5, 8, 11**  
component **6**  
heuristic algorithm **3**  
for travelling salesman problem **4**  
Prüfer sequence **14**  
Reuleaux pairs **20**  
travelling salesman problem **4, 15**

## Introduction

Page 14 In the middle of the third paragraph, split the sentence ‘This is feasible if ...’, by replacing ‘, since’ with ‘. Since each route can be traced in either direction.’. In addition, halve the numbers to get  $\frac{1}{2}(9!) = 181440$  in about 3 minutes, and  $6.08 \times 10^{16}$  in roughly 2 million years.

Page 38 **Heuristic algorithm for the travelling salesman problems**

Insert a third margin note: ‘We assume that the triangle inequality is satisfied; that is, there is no triple of vertices such that the weight of edge AC is greater than the sum of the weights of AB and BC.’

Page 40 In the top table, the time taken for the exhaustion algorithm for 15 workers should be 41.5 years, not 45 years.

Page 55 In **Solution 2.11**, the margin note should start ‘Note that there are other ways of achieving this maximum flow of traffic, for example: ...’

Page 55 In **Solution 3.3**, reverse the direction of one of the two Everton–Chelsea edges in the middle graph.

Page 56 In **Solution 3.5(a)** the values for AC should be 2,2 and not 2,4 in the second diagram.

## Graphs 1

Page 21 In the middle of the page, delete the word ‘non-’ from ‘non-isomeric’ giving: ‘... *isomer enumeration* – the determination of the number of isomeric molecules with a given formula.’

Page 75 In **Solution 1.8**, replace four occurrences of the word ‘cycle’ by ‘closed walk’ in the third paragraph and the figure, and insert the following paragraph between ‘Let  $G$  be a connected graph in which each cycle has even length.’ and ‘Choose any vertex  $v$  in  $G$ .’ in the second paragraph: ‘We first show that  $G$  contains no odd length closed walks. Suppose to the contrary, and take a shortest closed walk of odd length in  $G$ . This walk cannot be a cycle and so can be split into two shorter closed walks. One of these shorter closed walks must be of odd length, which contradicts the first being the shortest. Therefore every closed walk in  $G$  has even length.’

Page 78 In **Solution 3.1**, part (c)(2), for length 2, delete the word ‘multiple’.

## Graphs 2

Page 33 Just above the final table, replace AMDHL with Amdahl.

Page 57 In **Solution 3.3(a)** replace the edge  $hj$  in the example with the edge  $ij$ .



### Graphs 3

- Page 22 After the definition of a map, insert the following after the sentence 'We refer to a face of a map as a *country*.'  
'The definition of a map implies that the outside region (the *infinite face*) is a country, although it is often not regarded as such. As explained on page 30 of the Television Notes, it is immaterial whether or not this region is included in a colouring of the map.'
- Page 35 In Example 3.2: map colouring, the black circle labelled A (with 6 edges from it) in the figure should be a black triangle, and Arkansas should be in the colour class black triangle not black circle.
- Page 55 At the bottom of the page, delete the unnumbered vertex and its edge to vertex 9 from the graph for the Purple Peril bus company.

### Graphs 4

- Page 43 Insert a margin note beside the definition of a ***k*-screen**: 'The columns of a *k*-screen are numbered from left to right and the rows from top to bottom.'
- Page 62 In **Exercise 5.1**, insert the word 'not' to get 'The hiker does not want ...'.
- Page 63 In **Solution 1.1**, replace ' $2^n < (n + 1)!$ ' by ' $2^{n+1} < (n + 1)!$ '.
- Page 67 In **Solution 5.2** bubble 4, replace '496' by '510', and start the backtrack arrow here. Also, delete bubbles 6 and 7.
- Page 68 In **Solution 1.3**, replace ' $n > 1$ ' by ' $n > 2$ ' (twice), and ' $n(> 1)$ ' by ' $n(> 2)$ '.
- Page 76 In the *sixth branching*, the second set of edges should emanate from the top vertex (0, 1, 0, 0, 0) not the central one (0, 0, 1, 0, 0).
- Page 78 In **Solution 5.2**, in the table for branch 1 of the *first branching*, the bottom left-hand entry (EA) should be ' $0^2$ ' and not ' $0^0$ '.
- Page 79 Also in **Solution 5.2**, in the table for branch 7 of the *third branching*, replace the final column label '0' with the label '*D*', and branch 8 in the tree should say 'include *BC*, *ED*' not 'exclude'.

### Networks 1

- Page 55 In **Solution 4.3(c)** the minimum cut should be '{SA, AB, BC, BD}' rather than '{CT, DT}'.

Page 11

**Algorithm for finding an Eulerian trail in a digraph**

Insert a margin note: 'For efficiency, the algorithm actually finds a collection of closed trails, each of which may or may not be a single cycle.', and delete the margin note near the end. In addition, replace each occurrence of the word 'cycle(s)' in the algorithm with 'closed trail(s).'

Page 15

In **Section 2.1**, it should say 'The associated frames are in *Audio-tape Notes 1*' not *Notes 2*', and the tape symbol is missing in the margin.

Page 33

In lines 5 and 7, replace the second 'l' by a 'c' to get ' $l_6 - c_{4,6}$ ' and ' $l_5 - c_{4,5}$ ', respectively.

Page 44

In line 12 from the bottom, replace the ' $\times k$ ' by '+1' to get ' $\frac{1}{2}(n-1)+1$  bins'.

Page 53

In **Exercise 4.7**, mark the critical path through *C*, *G* and *K* on the diagram.

Page 57

In **Solution 1.4**, in both  $C^3 = C^2 \# D$  and  $C^4 = C^3 \# D$ , swap the entry '0' in matrix  $C^3$  row 1 column 3 with the entry 'bdac' in row 2 column 3.

Page 59

In **Solution 2.4**, swap the third and fourth rows (*C* and *D*), insert a '*D*' at the end of the third iteration name, delete the fourth iteration name, and rename the fifth and sixth iteration names to ' $4(S, A, B, C, D, E)$ ' and ' $5(S, A, B, C, D, E, F)$ ', respectively, to get:

iteration	vertices assigned labels	origin vertices							vertex	distance from <i>S</i>
		<i>S</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>		
1 ( <i>S</i> )	<i>A</i>	1							<i>A</i>	1
2( <i>S</i> , <i>A</i> )	<i>B</i>	3	6						<i>B</i>	6
	<i>D</i>		3						<i>D</i>	3
3( <i>S</i> , <i>A</i> , <i>B</i> , <i>D</i> )	<i>C</i>	6		8					<i>C</i>	8
	<i>E</i>		5	13		4			<i>E</i>	13
4( <i>S</i> , <i>A</i> , <i>B</i> , <i>C</i> , <i>D</i> , <i>E</i> )	<i>F</i>			9	14		17		<i>F</i>	17
5( <i>S</i> , <i>A</i> , <i>B</i> , <i>C</i> , <i>D</i> , <i>E</i> , <i>F</i> )	<i>T</i>					10	18	19	<i>T</i>	19

Page 60

In **Solution 2.5**, insert '12' in row *F* column *C*, and '20' and '19' in row *T* columns *E* and *F*, respectively.

Page 61

In **Solution 3.2**, in the last line replace '*DH*' by '*GH*'.

Page 66

In **Solution 3.6(c)**, in the first table insert '5' in column  $l_i$  of the first  $i = 1$  row and delete the '8' from this column in the second  $i = 1$  row. Then in the first  $i = 0$  row of this table, and the  $i = A$  row of the second table, change the two occurrences of '8' to '5'.

Page 68

In **Solution 4.3**, swap the activities *D* and *E* in the first schedule.

In **Solution 4.5(a)**, in the diagram activity *I* should end at 11 not 10 (that is, the durations of *I* and *H* are 3 and 2 respectively).



- Page 69 In **Solution 4.5(b)**, in the first diagram activity  $I$  should come before activity  $F$  with  $I$  ending at 11 and  $F$  at 13. In the second diagram, activity  $I$  should again end at 11 not 10.
- Pages 75, 76 In **Solution 1.7**, replace 'cycle' by 'closed trail' in the headings of the tables.
- Page 79 In **Solution 3.2**, replace the first two paragraphs with 'There are five redundant arcs:  $FI$ ,  $DJ$ ,  $EJ$ ,  $FH$  and  $DC$ .'
- Page 81 In **Solution 3.5(e)**, in the second sentence delete the word 'also' and insert 'a further' to get 'So if activity 6 is delayed by a further 2 days, ...'.

### Networks 3

- Page 62 In **Solution 4.1**, in the diagram for Part A delete the label  $A_2$  beside the vertex  $b_3$ .

### Networks 4

- Page 6 In diagram (b), about two thirds down the page, insert a small black blob in the top left corner between the current source and resistor.
- Pages 44, 45 In the two large matrix equations, delete the first '=', and in the second also delete the subscript '1' to get '-V'.
- Page 52 In the first matrix equation, the second '1' in the top row of the left-hand matrix should be a '0', making the row '000 : 100'.
- Page 57 In **Problem 3.4(b)**, the final entry of the second row of the matrix in the second equation should be '1' not '0', making the row '0 1 -1 1'.
- Pages 60, 64 In **Exercise 1.10(b)** and **Solution 1.10(b)**, interchange the labels (subscripts) 2 and 4, and 3 and 5, to get:

**Exercise:**  $v_1 = 3$ ,  $v_2 = 4\frac{di_2}{dt}$ ,  $i_3 = 6\frac{dv_3}{dt}$ ,  $v_4 = 10i_4$ ,  $v_5 = 5i_5$ .

**Solution:**  $i_1 = 3$ ,  $i_2 = 4\frac{dv_2}{dt}$ ,  $v_3 = 6\frac{di_3}{dt}$ ,  $i_4 = 10v_4$ ,  $i_5 = 5v_5$ .

- Page 61 In **Exercise 2.4**, edge 9 should be thick rather than edge 8 in the first oriented graph, and in the second, edge 1 should be thick not edge 2.
- Page 65 In **Solution 2.1(b)**, the edge  $DE$  should be thick in each of the four diagrams.
- Page 68 In **Solution 3.2(b)**, the last two currents in the vector  $\mathbf{x}$  given in the **H**-matrix equation should be swapped; that is,  $i_4$  and  $i_2$  interchanged.

### Design 2

- Page 73 In **Solution 3.3**, replace the second paragraph with the following:  
 'A suitable quantity to describe its pose is the angle  $\theta$  between the edge of the slab and the straight line on which vertex  $A$  is constrained to lie. This angle gives a unique position for the slab and hence fully describes its pose. (Note that there are two possible positions for the slab for most positions of vertex  $A$  along the straight line on which  $A$  is constrained to lie.)'  
 On the diagram, delete the arrow and its label  $d$  and add an angle  $\theta$  (either acute or obtuse) between the lower line and the edge  $AC$ .

In **Solution 1.10**, replace the first sentence with the following ‘Generally kinematic systems *look like* their direct graphs, so, if the six interchange graphs are treated as direct graph representations, the kinematic systems that they appear to represent are shown below.’

Below the figure, add the following paragraph: ‘However, we are unable to draw the direct graphs of three of the above systems because they have unary links which cannot be represented by an edge. A simple connected planar graph can only be a *direct graph* representation of a kinematic system if all vertices have degree at least two, since a joint needs to join at least two links. Therefore only three of the interchange graphs may be treated as direct graph representations of valid kinematic systems.’

### Design 3

- Page 12 In line 6, replace ‘ $\delta/2$ ’ by ‘ $(\delta - 2)/2$ ’
- Page 17 In the paragraph after the boxed definition, the final sentence should say: ‘If column  $i$  of  $\mathbf{I}_k$ , forms column  $j$  of  $\mathbf{G}$ , then the  $i$ th bit of each message appears as the  $j$ th bit of the corresponding codeword.’
- Page 21 Under the photograph insert ‘1998’, for the year Hamming died.
- Page 26 In **Theorem 3.2** delete ‘a code with a systematic encoding rule – that is,’.  
At the end of the box at the bottom of the page, insert ‘, and conversely, if the generator matrix  $\mathbf{G}$  is expressed in standard form  $\mathbf{G} = [\mathbf{I}|\mathbf{A}^T]$ , then the matrix  $\mathbf{H} = [\mathbf{A}|\mathbf{I}]$  is a parity check matrix for  $C$ ’.
- Page 38 In the second paragraph replace ‘(16,5,4)’ by ‘(16,5,8)’.
- Page 40 Under the photograph insert ‘1989’, for the year Golay died.
- Page 44 In the 10th row of the  $16 \times 16$  array swap the 12th and 13th entries, making the row ‘0 1 0 1 0 1 0 1 1 0 1 0 1 0 1 0’.
- Page 61 In **Solution 2.8(b)**, the final phrase should say ‘so the Hamming inequality is not satisfied.’
- Page 72 In **Solution 3.7**, replace ‘Theorem 3.2’ by ‘Theorem 3.5’.

### Design 4

- Page 13 The block table at the bottom of the page should read:
- |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|
| $A$ | $A$ | $A$ | $B$ | $B$ | $C$ |
| $B$ | $C$ | $D$ | $C$ | $D$ | $D$ |
- Page 26 In **Example 2.3** the text below the block table should read:  
‘We construct a **table of differences** by writing the starting block on the left and at the top of the table, as follows:’
- Page 35 In the **Proof of Theorem 3.2**, in line 15 from the bottom replace ‘pass through’ by ‘lie on’, and ‘points’ by ‘lines’ to get: ‘... and any two points lie on the same number of lines.’
- Page 51 The second BIBD at the foot of the page should be labelled ‘design 2’.
- Page 70 In **Solution 2.10**, replace ‘Problem 1.16’ by ‘Problem 1.15’.



## Audio Notes 1

- Page 7 In the first graph of the 4th iteration, the label on arc  $SB$  should be '3,5'.
- Page 28 In part (d), insert the label ' $D$ ' below the lowest vertex in the network.
- Page 29 In the *fifth iteration*, replace the ' $D, E$ ' in the min cut by ' $E, F$ ' to get: 'min cut separates  $\{D\}, \{A, B, C, E, F\}$ '.
- Page 46 In the fifth line of text replace ' $A$ ' by ' $S$ ' to get '... 13 assigned from  $S$ '.

## Audio Notes 2

- Page 12 In Part C (Step 6) the second row of the right-hand matrix should be labelled ' $x_3$ ' not ' $x_2$ '.
- Page 22 In the *third branching*, the red number ones may be missing from the three vectors: ' $(1, 1, 1, 0, 0)$ ', ' $(1, 1, 0, 1, 0)$ ' and ' $(1, 1, 0, 0, 1)$ '.

## Networks 3 CD Transcript and Audio track 22

- Page 11 The algorithm is applied incorrectly! The transcript and audio say  
2:00-2:30 'Finally, we increase by 1 the non-zero costs of edges joining an unlabelled  $x$  to a labelled  $y$ .' however **all** costs of edges joining an unlabelled  $x$  to a labelled  $y$  should be increased by 1. The audio notes are correct, and the Networks 3 eTutorial teaches this material well.

## 'Errors aren't forever' Band 6 on course software DVD

In the 3-circles animation, the pink circles 6 and 7 should be interchanged.

## Specimen exam solutions

- Question 16(b) The final column vector should comprise 4 zeros not 6.
- Question 18(b)  $L_1$  part (iii), the second grid point should be ' $(2, 3)$ ' and not ' $(2, 4)$ '.